CLAIMS

What is claimed is:

1.   A receiver system comprising:

a front end portion that receives and digitizes a data signal having one or more training tones and one or more data tones; and

a channel estimator component that utilizes the digitized data signal to provide a partial channel estimate that is combined with at least one other partial channel estimate to provide an aggregated channel estimate.

2.   The system of claim 1, the channel estimator component being adapted to update the aggregated channel estimate every K data signals, where K is the number of partial channel estimates forming a full channel estimate.

3.   The system of claim 1, further comprising a burst counter that increments a count value on receipt of an incoming data signal, the count value determining which partial channel estimate is updated.

4.   The system of claim 3, the count value being incremented modulo K, where K is the number of partial channel estimates forming a full channel estimate.

5.   The system of claim 1, the channel estimator component extracts training tones from the data signal and determines an average channel impulse response from the training tones, the average channel impulse response being utilized to determine the partial channel estimate.

6.   The system of claim 5, the channel estimator component further comprising a frequency shifter that shifts a spectrum of the average impulse response upon receipt of a data signal to provide N/K time samples to an N/K point Fast Fourier Transform component where N is the number of tones in a data signal and K is the

number of partial channel estimates forming a full channel estimate, the N/K point Fast Fourier Transform component providing a partial channel estimate corresponding to the received data signal.

7. The system of claim 6, the frequency shifter shifting the spectrum of the average impulse response based on a count value that is incremented modulo K, such that a different partial channel estimate is determined based on the count value and a full channel estimate is updated every K data signals.

8. The system of claim 6, the frequency shifter shifting the spectrum of the average impulse response by multiplying the average impulse response by a frequency shift factor.

9. The system of claim 6, K being a power of 2.

10. The system of claim 1, the data signal being transmitted in a multicarrier modulation format.

11. The system of claim 1 being implemented as part of a modem.

12. The system of claim 1 being implemented as part of a wireless communication system coupled to the Internet.

13. A channel estimator comprising:
a Fast Fourier Transform portion that receives a channel impulse response and performs a Fast Fourier Transform on the channel impulse response to provide a partial channel estimate; and

a combiner that combines the partial channel estimate with at least one other partial channel estimate to provide an aggregated channel estimate.

14. The channel estimator of claim 13, the channel impulse response being determined using training tones embedded in a data burst and a zero pad component that adds zeroes to the channel impulse response until the channel impulse response has N/K number of time samples where N is the total number of tones in a data burst and K is the number of partial channel estimates that form a full channel estimate.

15. The channel estimator of claim 13, further comprising a frequency shifter component that frequency shifts the spectrum of the channel impulse response based on a burst count value that is incremented modulo K when a new data burst is received, where K is a reduction factor for the Fast Fourier Transform portion, such that the Fast Fourier Transform portion performs an N/K point Fast Fourier Transform on the channel impulse response where N is the total number of tones in a data burst.

16. The channel estimator of claim 13, further comprising a frequency shifter component that frequency shifts the spectrum of the channel impulse response upon receipt of a new data burst to provide a new set of N/K points to the Fast Fourier Transform portion where N is the total number of tones in a data signal and K is the number of partial channel estimates, such that a full channel estimate is updated every K data signals.

17. The channel estimator of claim 16, the shifter component comprising a frequency shift factor multiplier.

18. The channel estimator of claim 16, K being a power of 2.

19.   The channel estimator of claim 16, further comprising a register bank having K tone set registers for storing channel estimate values based on different partial channel estimates, one of the K tone set registers being updated for each data signal that is received.

20.   The channel estimator of claim 19, further comprising a multiplexer coupled to a burst counter that increments repeatedly between 0 and K-1 upon receipt of data bursts, such that the multiplexer updates one of the K tone set registers based on the state of the burst counter.

21.   The channel estimator of claim 13 forming part of an application specific integrated circuit.

22.   The channel estimator of claim 13 being implemented as executable instructions programmed in a digital signal processor.

23.   A wireless communication system comprising:

an Inverse Fast Fourier Transform component operative to receive training tones extracted from a digitized data signal and provide a channel impulse response;

a frequency shifting component that shifts the spectrum of the channel impulse response based on a burst count value;

a Fast Fourier Transform portion that receives the frequency shifted channel impulse response and performs a Fast Fourier Transform on the frequency shifted channel impulse response to provide a partial channel estimate; and

a combiner that combines the partial channel estimate with at least one other partial channel estimate to provide an aggregated channel estimate.

24.   The system of claim 23, the data signal being transmitted in a multicarrier modulation format.

25.   A method for performing a channel estimation procedure comprising:
extracting training tones from a digitized data burst;
determining a channel impulse response based on the extracted training tones;
frequency shifting the spectrum of the channel impulse response; and
performing a Fast Fourier Transform on the frequency shifted channel impulse response to provide a partial channel estimate.

26.   The method of claim 25, further comprising combining the partial channel estimate with partial channel estimates corresponding to previously received digitized data bursts to provide an aggregated channel estimate.

27.   The method of claim 25, the frequency shifting the spectrum of the channel impulse response comprising evaluating the expression:

$$h'_{avg}(n) = h_{avg}(n) \cdot e^{-j2\pi nb/N} \quad ; \quad n = 0, \cdots, s-1$$

where n is the sample number, s is the number of samples, b is a burst count value and N is the total number of tones in the digitized data burst.

28.   The method of claim 25, the frequency shifting the spectrum of the impulse response comprising multiplying the channel impulse response by a frequency shift factor.

29.   The method of claim 28, further comprising incrementing a burst counter having a burst counter value, the burst counter value changing the frequency shift factor multipliers for each data burst received, so that different partial channel estimate can be determined for each data burst.

30. The method of claim 29, the burst counter having a burst value being incremented modulo K for each data burst received, where K is the number of partial channel estimates that form a full channel estimate.

31. The method of claim 25, further comprising zero padding the frequency shifted channel impulse response to provide N/K number of time samples where N is the total number of tones in a data burst and K is the number of partial channel estimates that form a full channel estimate.

32. The method of claim 25, further comprising dividing the total number of tones N in a data burst into K sets such that $1/K^{th}$ of the channel estimates are updated for each data burst received and a full channel estimate is updated every K bursts.

33. The method of claim 25, the performing a Fast Fourier Transform on the frequency shifted channel impulse response comprising performing a N/K point Fast Fourier Transform where N is the total number of tones in a data burst and K is the number of partial channel estimates that form a full channel estimate.

34. A digital signal processor employing computer executable instructions for performing the method comprising:

extracting training tones from a data burst;

determining a channel impulse response based on the extracted training tones;

frequency shifting the spectrum of the channel impulse response;

performing a Fast Fourier Transform on the frequency shifted channel impulse response to provide a partial channel estimate; and

combining the partial channel estimate with at least one other partial estimate to form an aggregated channel estimate.

35.   The digital signal processor of claim 34, further comprising combining the partial channel estimate with partial channel estimates corresponding to previously received data bursts to provide a full channel estimate.

36.   The digital signal processor of claim 35, further comprising dividing the total number of tones N in a data burst into K training sets such that $1/K^{th}$ of the channel estimates are updated for each data burst received and a full channel estimate is updated every K bursts.

37.   The digital signal processor of claim 34, the performing a Fast Fourier Transform on the frequency shifted channel impulse response comprising performing an N/K point Fast Fourier Transform where N is the total number of tones in a data burst and K is the number of partial channel estimates that form a full channel estimate.

38.   A system for determining the effects of a transmission environment on a transmission signal, the system comprising:

    means for extracting training tones from a received data signal;

    means for determining a channel impulse response based on the extracted training tones;

    means for frequency shifting the spectrum of the channel impulse response;

    means for performing a Fast Fourier Transform on the frequency shifted channel impulse response to provide a partial channel estimate; and

    means for combining the partial channel estimate with other partial channel estimates determined for different data signals to provided an aggregated channel estimate.

39.   The system of claim 38, a full channel estimate provided in K number of data signals, where K is the number of partial channel estimates that form a full channel estimate.